



Water budget and integrated flow model of Walker Lake, Nevada

In cooperation with Bureau of Reclamation

Kip K. Allander and Thomas J. Lopes

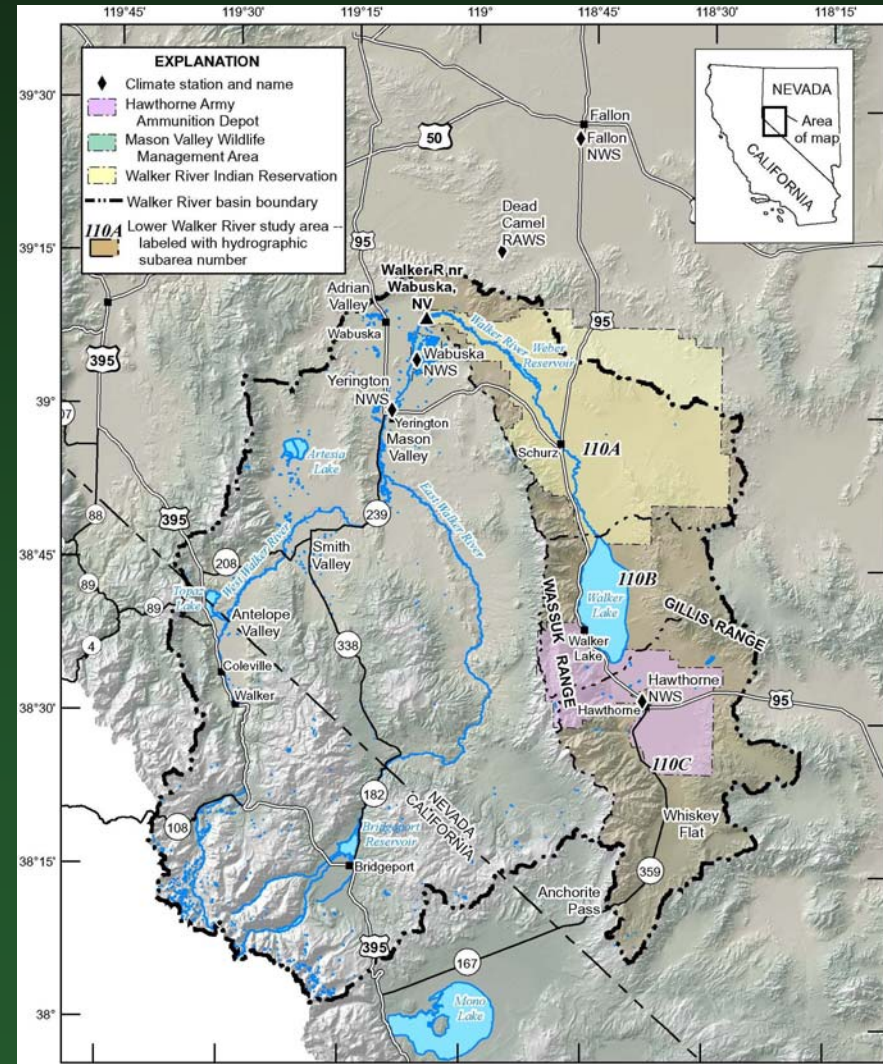
2008 Annual Nevada Water Resources Association Conference

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Mesquite, NV

Outline

- Overview of recent work by USGS
- Water Budget
- Integrated flow model
- Information Products



Overview of USGS Activities

- Study began in spring of 2004
- Major objectives are to:
 - Quantify streamflow in the Walker Basin
 - Estimate ET from the lake and vegetation
 - Develop an improved water budget for Walker Lake
 - Develop capability to predict how changes in upstream water management will affect streamflow deliveries to Walker Lake

Overview of USGS Activities (cont)

- **Extensive data collection**
 - SW network (19 stream gages, 4 lake gages)
 - GW network(>200 wells)
 - ET network (11 stations)
 - Aquifer tests, geophysics
 - Geochemical data
- **Mapping: Bathymetry & Remote sensing (Lidar, imagery)**

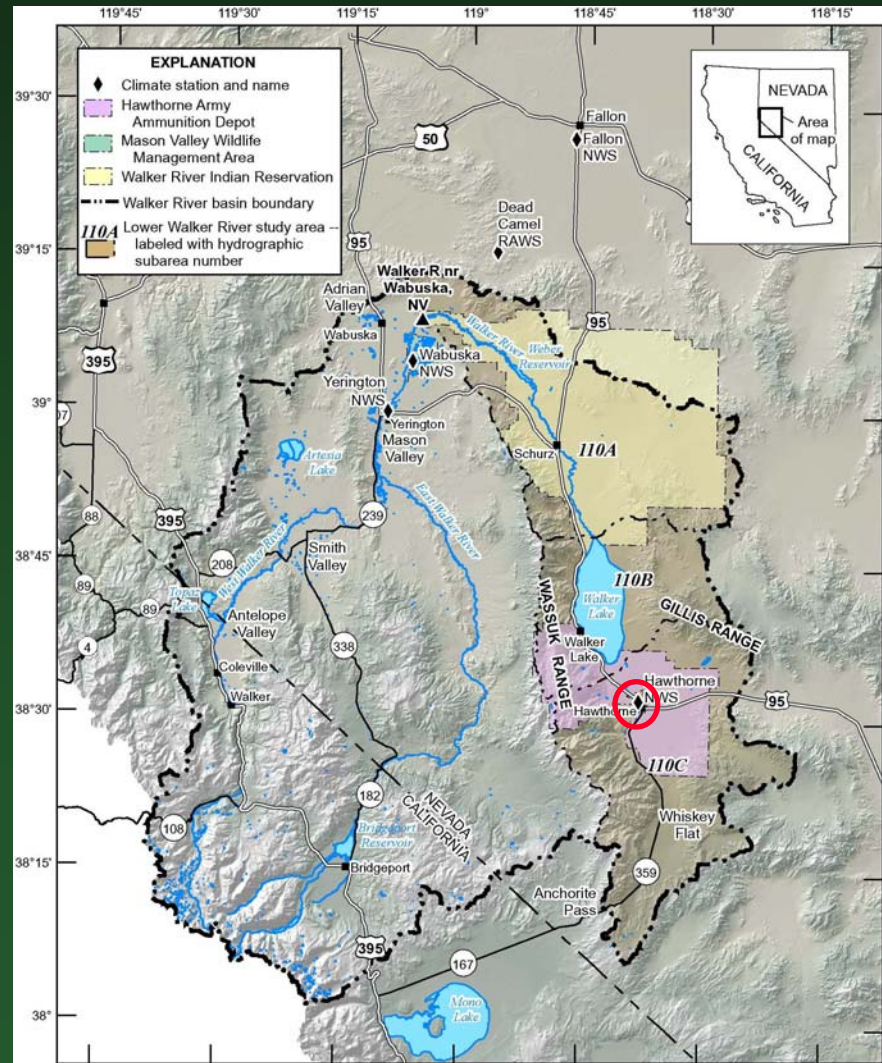
Walker Lake Water Budget

$$\text{Precip} + \text{SW} + \text{GW} - \text{E} = \Delta\text{Storage}$$

- Summarized over 13-year period of 1995-2007.
 - Uses actual year to year data for each component.
 - Average lake area is 34,000 acres.

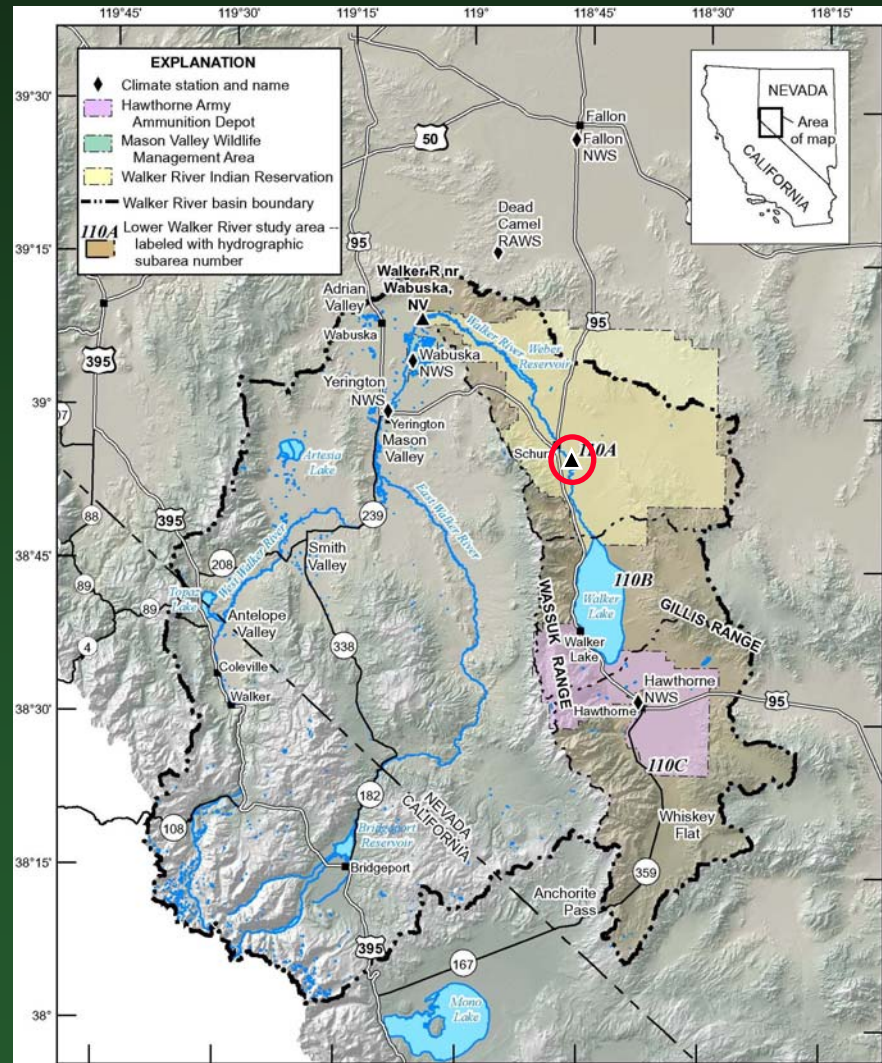
Water Budget - Precipitation

- For 1995-2007, precipitation is 0.32 ft/yr
- 11,000 ac-ft/yr



Water Budget – Stream inflow

- 1995-2007
117,000 ac-ft/yr.

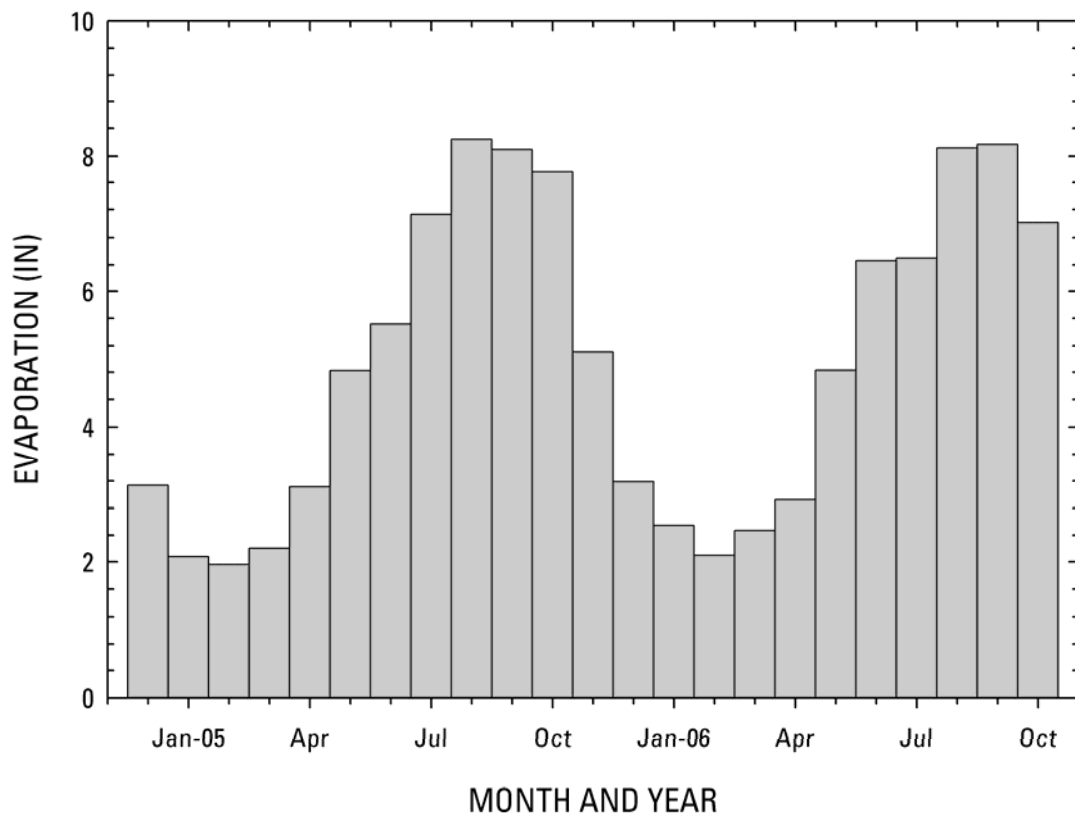


Water Budget - evaporation



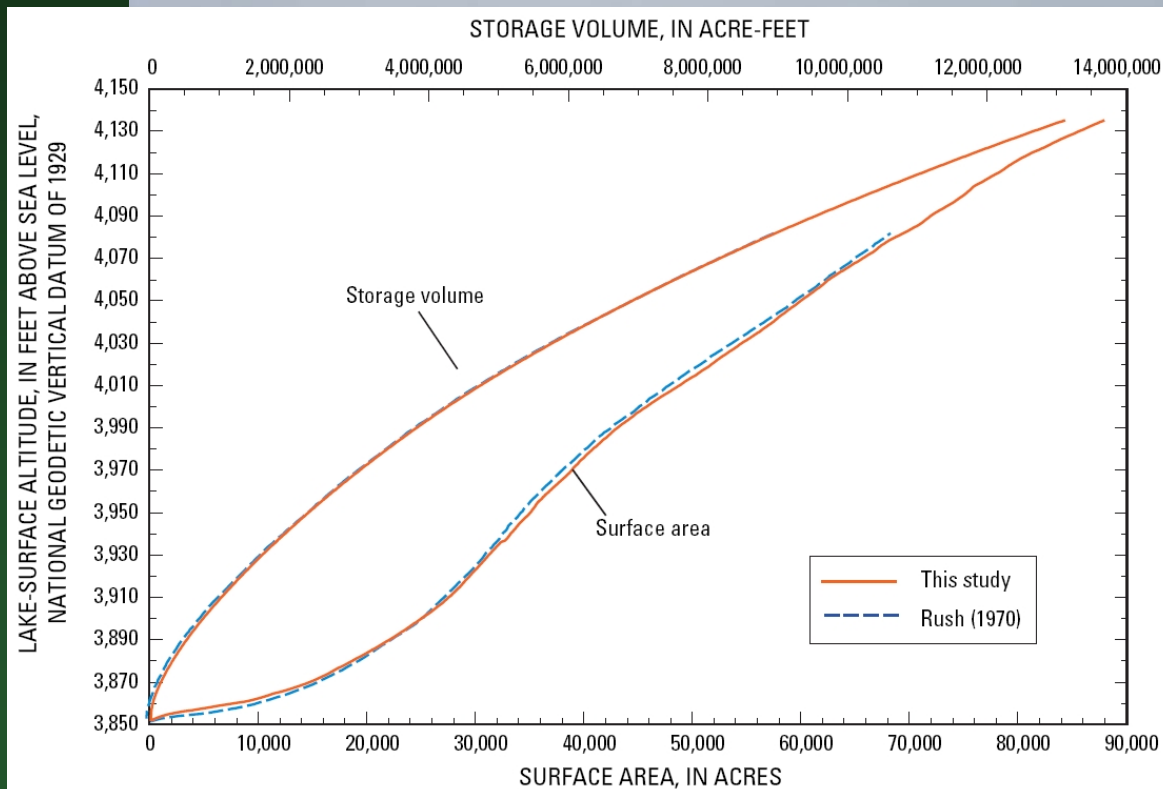
Water Budget - evaporation

- 4.9 ft/yr
- For 1995-2007
167,000 ac-ft/yr



Water Budget – Δ storage

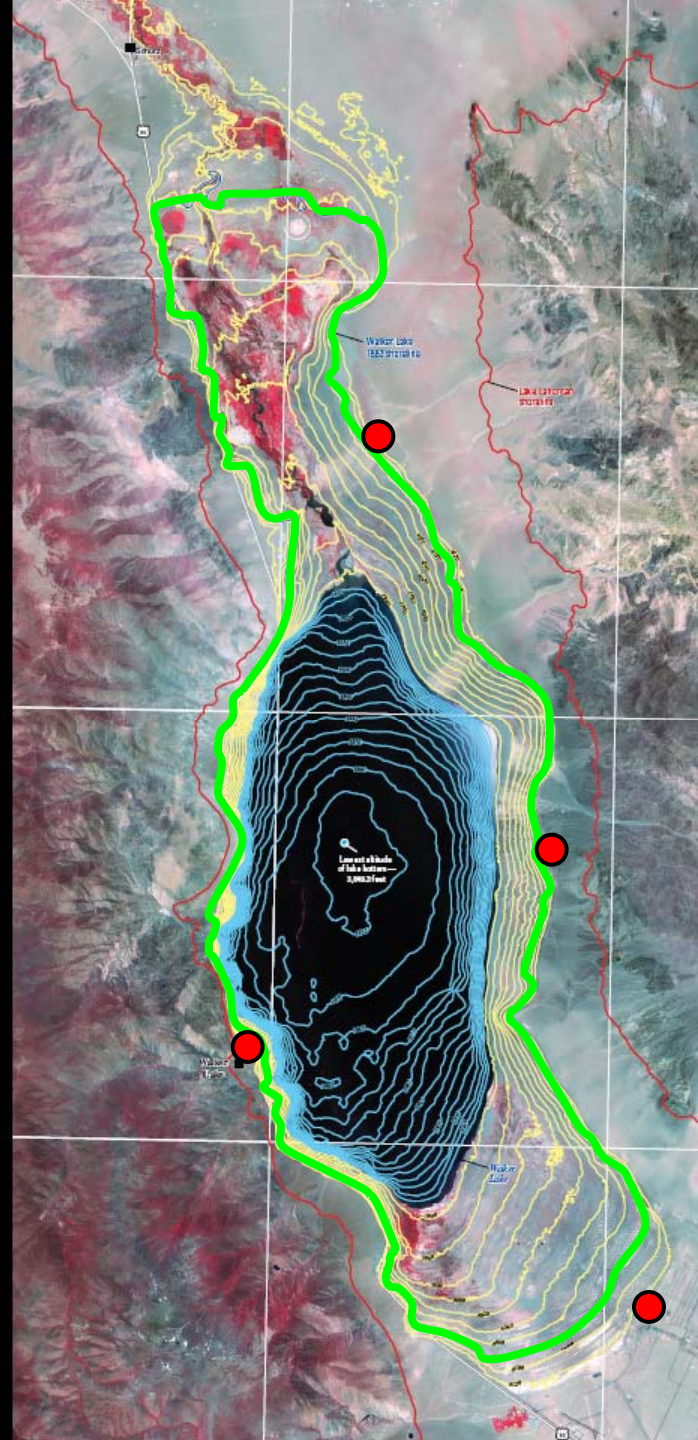
- Bathymetric survey was redone winter 2005.
- Used differential GPS, single-beam sonar. Measured along 250 miles of transects.
- For 1995-2007 -19,000 ac-ft/yr.



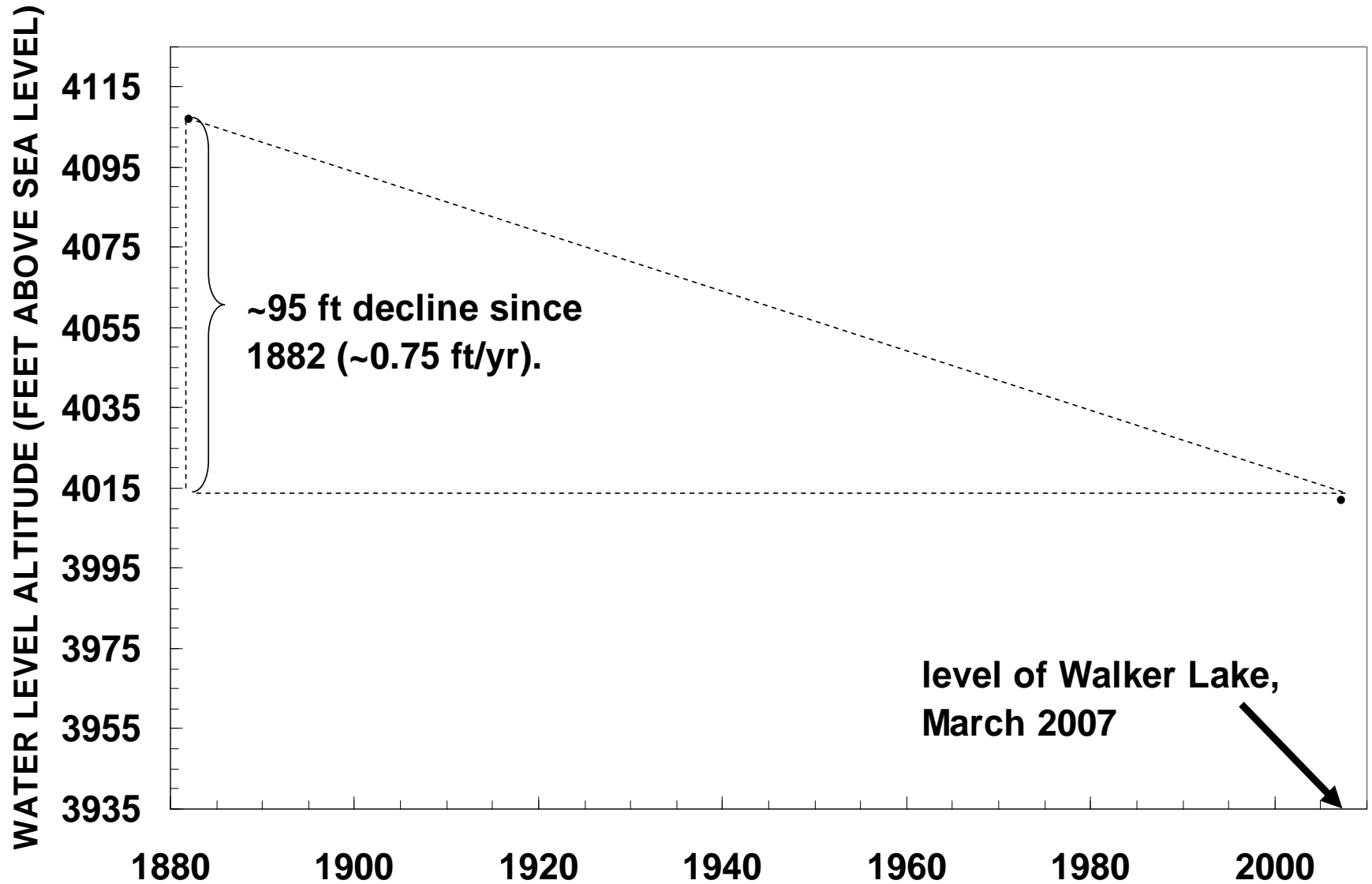
Water Budget – Ground water

- Most difficult of all components to independently estimate.
- Could be solved as residual of water budget but then would incorporate all uncertainty.
- Work is in progress and is too early to estimate.
- GW interacts dynamically with changing lake stage and is major component of integrated hydrologic model.

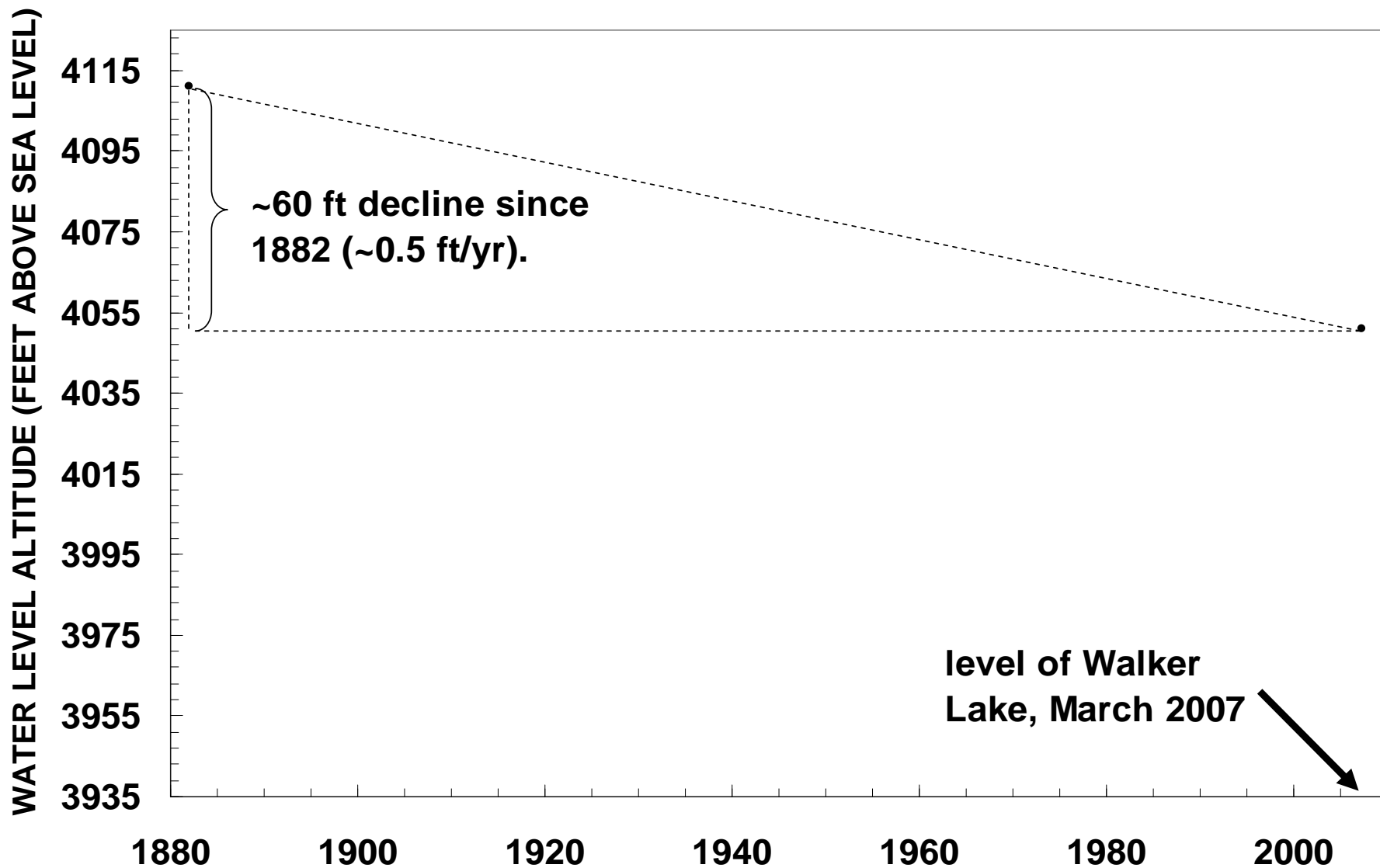
1882 and 2005 shorelines



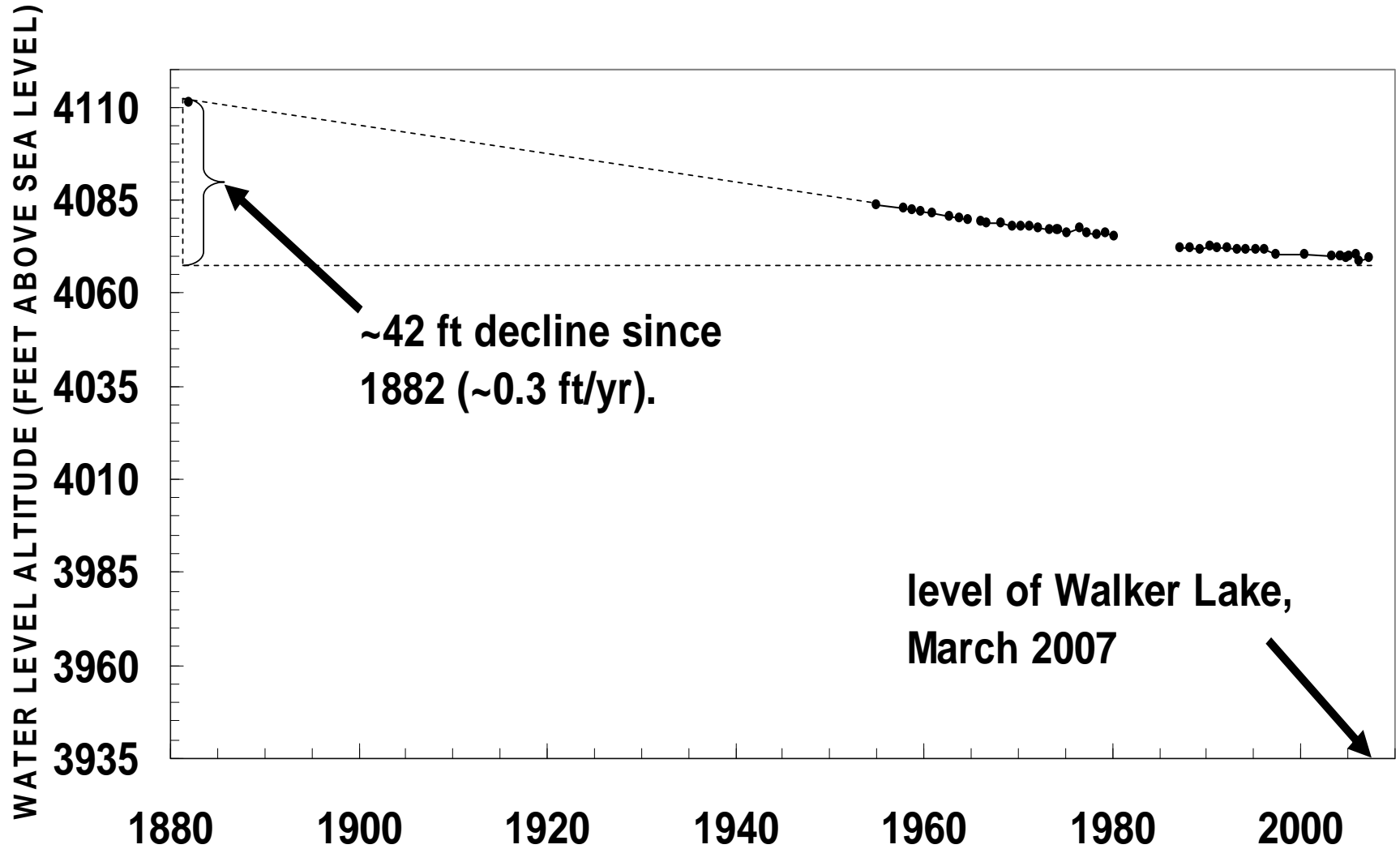
Hydrograph for observation well two miles north of Walker Lake



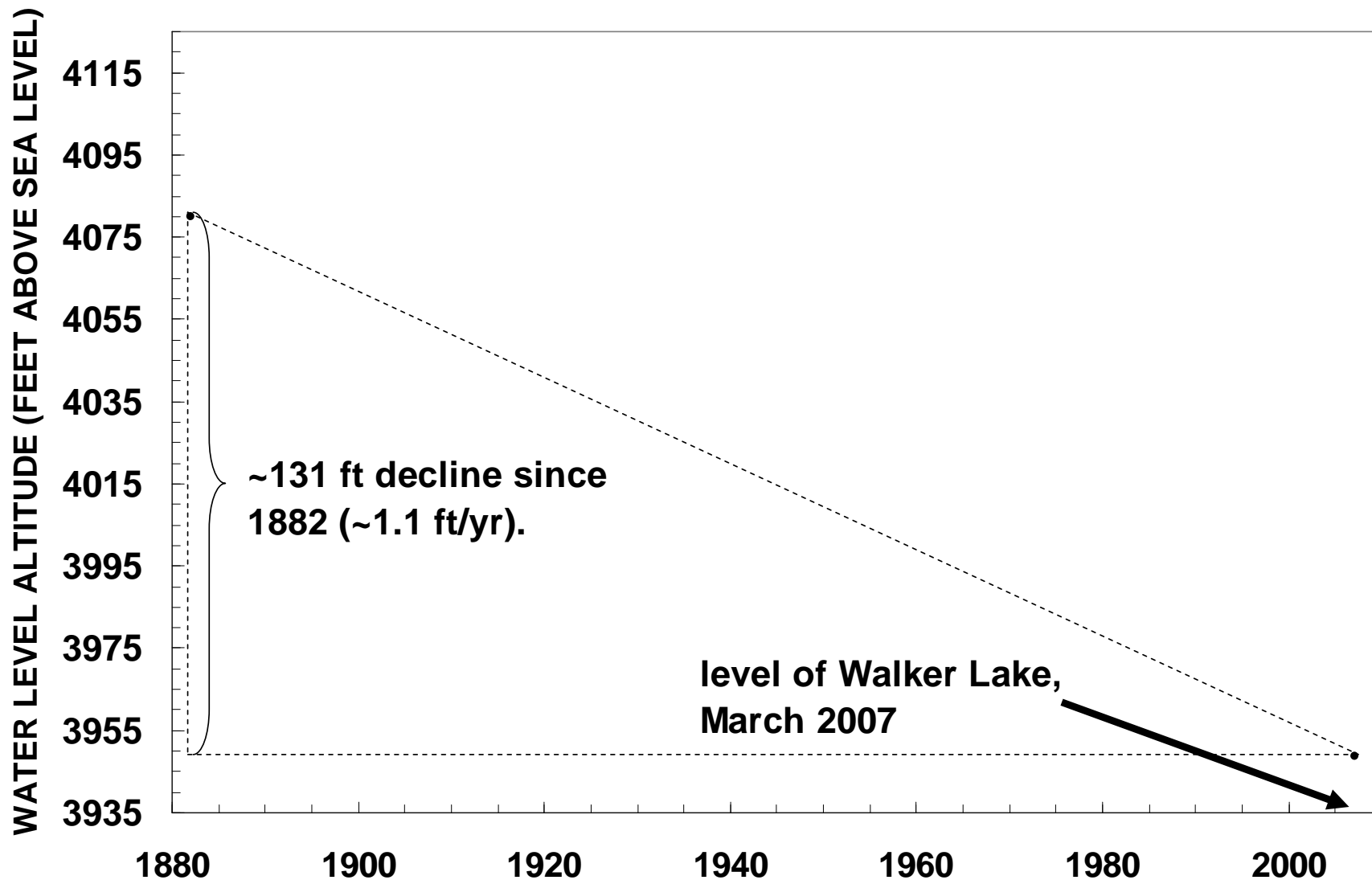
Hydrograph for observation well one mile east of Walker Lake



Hydrograph for unused production well 4.5 miles south of Walker Lake



Hydrograph for private well 0.4 miles west of Walker Lake



Walker Lake Water Budget* – 1995-2007

Component	(x1000 ac-ft/yr)
Walker River	117
Precipitation	11
GW	>0
Inflow	>127
Evaporation	167
Outflow	167
Lake storage	19
Storage Change	19
Residual	<20

Integrated model objectives

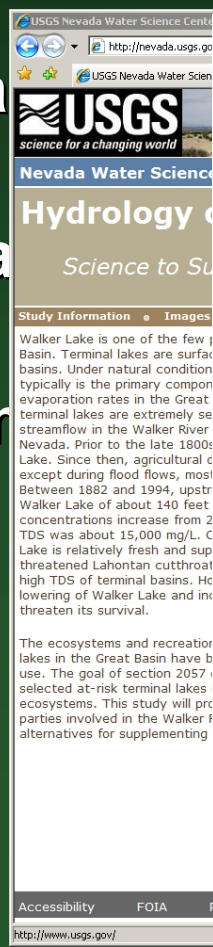
- Refine understanding of aquifers around Walker Lake and how lake, river, aquifers interact.
- Refine estimates of ground-water discharge to Walker Lake.
- Estimate how water deliveries to the Wabuska stream gage will effect lake levels and TDS concentrations in Walker Lake.

Approach

- **Construct GW/SW model using GSFLOW.**
- **Refine hydrogeologic understanding of GW system and interactions with SW systems.**
- **Assess the effects of water management alternatives on Walker Lake-levels and TDS.**

Completed products

- <http://nevada.usgs.gov/walker/>
- Walker Project Fact Sheet
- Bathymetry of Walker Lake
- Precipitation estimates (NWRA journal v. 2)



Science to Sustain Terminal Lakes: The Walker River Basin Study

Precipitation Zones of West-Central Nevada

THOMAS J. LOPES, U.S. Geological Survey, 2730 N. Deer Run Road, Carson City, NV 89701 (tjlopes@usgs.gov);

ROSE L. MEDINA, U.S. Geological Survey, 2730 N. Deer Run Road, Carson City, NV 89701 (rlmedina@usgs.gov)

ABSTRACT

Whether Nevada can sustain its fast rate of growth depends in part on accurately quantifying the amount of water that is available, including precipitation. The Precipitation-Zone Method (PZM) is a way of estimating mean annual precipitation at any point. The PZM was developed using data from west-central Nevada and northeastern California, but preliminary analysis indicates it can be applied to the entire state. Patterns in the spatial distribution of precipitation were identified by mapping station locations and plotting 1971-2000 precipitation normals versus station elevation. Precipitation zones are large areas where precipitation is linearly related to elevation. Four precipitation zones with different linear relations were delineated; these zones cover much of west-central Nevada. Regression equations with adjusted R^2 values of 0.89 to 0.95 were developed for each zone. All regression equations estimate similar precipitation rates at 4,000 feet, but the slopes of the regression equations become progressively shallower to the south. A geographic information system, 30-meter digital elevation model, and the regression equations were used to estimate the distribution and volumes of precipitation in each zone and in hydrographic areas of the Walker River Basin. Comparison between the PZM and Parameter-elevation Regressions on Independent Slopes Model (PRISM) indicate PRISM estimates are linearly related to elevation at low elevations in each zone, but PRISM estimates become non-linear at high elevations and are up to 2.5 times greater than the normals. However, PRISM under-estimates more than it over-estimates precipitation compared to the PZM. The PZM estimated the same or larger volumes of precipitation compared to PRISM in three of the zones, and the larger volumes mostly were from areas that receive greater than 15 inches/year of precipitation. Additional work is needed to accurately estimate mean annual precipitation throughout Nevada.

of the Basin to Walker Lake. The lower portion of the Basin was selected for study because (1) surface-water/ground-water interactions are complex and poorly understood, (2) few data are available, and (3) it is the terminal portion of the Basin and includes Walker Lake. The study will include the following tasks:



U.S. Department of the Interior
U.S. Geological Survey

USGS Fact Sheet 2005-2124
Last updated: November 2005

Accessibility FOIA

<http://www.usgs.gov/>

Products nearing completion

- **Evapotranspiration in the Lower Walker River Basin (publication around 9/2008).**
- **Hydrologic Setting and Conceptual Hydrologic Model of the Lower Walker River Basin (publication around 12/2008).**

Future products

- **Water Budget of Walker Lake (publication by 9/2009).**
- **Journal article on GW/SW interactions in a terminal lake (10/2010).**
- **Simulation of the Lower Walker River Basin Hydrologic System (10/2010).**

